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METHOD FOR IDENTIFICATION OF TEST PIECE AXES

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MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
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Price Rs 6·00 Gr 3 *April* 1978

Indian Standard
METHOD FOR IDENTIFICATION OF TEST PIECE AXES

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Indian Standard
METHOD FOR IDENTIFICATION OF TEST PIECE AXES

0. FOREWORD

0.1 This Indian Standard was adopted by the Indian Standards Institution on 15 November 1977, after the draft finalized by the Methods of Physical Tests Sectional Committee had been approved by the Structural and Metals Division Council.

0.2 The mechanical properties of a metallic product, especially those characterizing its deformability and toughness, such as breaking load, elongation, reduction of area, fracture, toughness and impact resistance, are dependent on the position in the product of the test piece on which these properties are measured. This standard provides a method for designating the position of the test piece in relation to its effect on these properties, and has been prepared on the basis of ISO/DIS 3785 — Draft International Standard ‘ Identification of test piece axes ’.

1. SCOPE

1.1 This standard covers the identification of test piece axes in relation to the direction of fibres by means of a system of coordinates.

1.2 It applies to both unnotched and notched metal test pieces.

1.3 The system presented is only intended to be applied in situations where a uniform fibring system may be unambiguously identified (*see also* **4.2** and Appendix A).

2. METHOD OF DESIGNATION

2.1 The method of designation is based on the assumption that a system of co-ordinates is laid into a metallic product so that:

a) the X-axis is coincident with the main direction of fibre deformation;

b) the Y-axis is normal to the X- and Z-axis;

c) The Z-axis is coincident with the direction of the main working force.

2.2 When applying this system to actual products, the following additional conditions shall obtain:

a) All test pieces normal to the fibre of products whose fibres have only one direction — so that, in accordance with the above definition, Y- and Z-test pieces are equivalent — shall be called Z-test pieces.

b) In cylindrical sections with a axial fibre, the radial direction shall be the *Z*-axis;

c) All test pieces parallel to the surface of sheets processed with the same degree of stretching in two directions normal to each other — so that, in accordance with the above definition, X- and Y-test pieces are equivalent — shall be called Y-test pieces.

2.3 This system offers the possibility of accurately designating all the positions of test pieces which may occur, and positions which do not coincide with any of the three axes of the system of co-ordinates may also be defined by a simple combination of the relative letters.

2.4 Examples of this system are as follows:

a) A test piece taken parallel to the deformation fibre of a bar (geometrically a longitudinal test piece) is an X-test piece (or lies in the direction of *X*).

b) A test piece taken normal to the deformation fibre (lamella) of a sheet so that its axis coincides with the broad side of the lamella (geometrically a transverse test piece) is a Y-test piece (or lies in the direction of *Y*).

c) A test piece whose axis lies through the thickness of a plate (short transverse test piece) is a Z-test piece.

d) Test pieces taken either longitudinally or transversely from a (thin-walled) tube with helical fibres are XY-test pieces.

2.5 The examples given in **2.4** and also further examples, applicable to unnotched test pieces, may be taken from Figures 1 to 5. It should, however, be noted that the scale of reproduction of these drawings is not the same in all cases and that the place where the test pieces are taken and the actul sampling do not always apply in practice. These drawings, and especially the positions of the test pieces, have been idealized so as to show as clearly as possible the various methods of designating the test piece position by the system of *X-Y-Z* co-ordinates. The position of the test pieces in actual products shall be taken from the relevant material specifications.

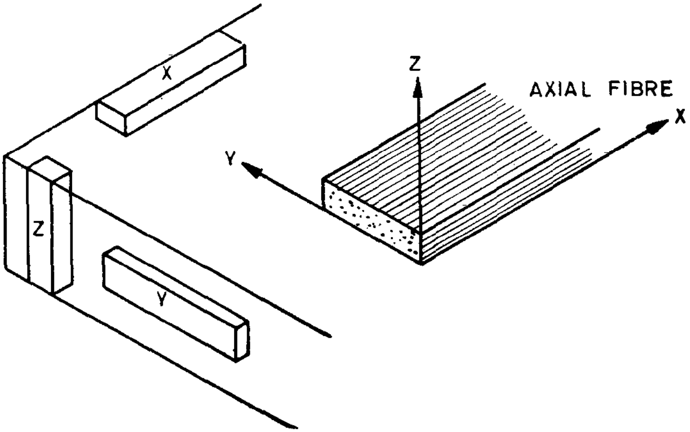

FIG. 1 FLAT ROLLED PRODUCTS

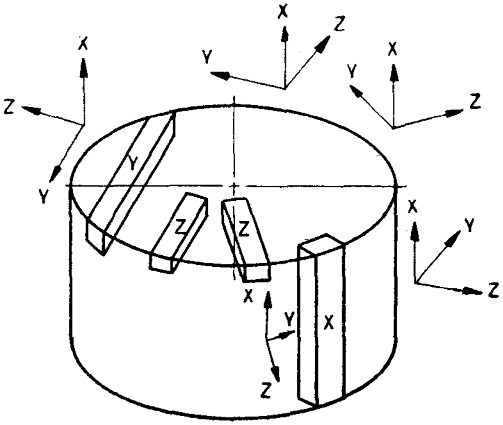

FIG. 2 CYLINDRICAL SECTION (AXIAL FIBRE)

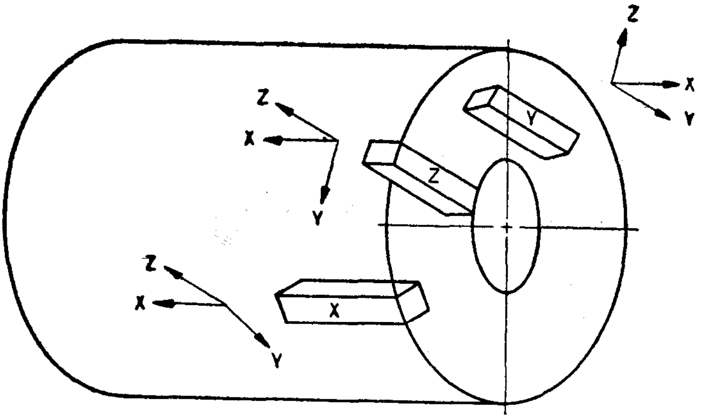

FIG. 3 TUBE (AXIAL FIBRE)

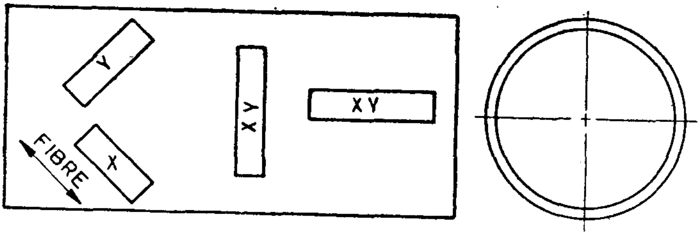

FIG. 4 THIN-WALLED TUBE WITH HELICAL FIBRE

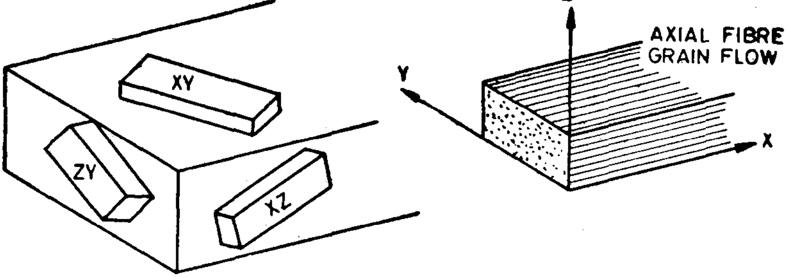

FIG. 5 NON-BASIC FLAT PRODUCT

3. IDENTIFICATION OF NOTCHED TEST PIECES

3.1 The system described in **2** also offers the possibility of combining the designation of the position of the axis of the test piece with the designation of the direction of propagation of fracture during a test. This is of importance in the case of notched test pieces or test pieces for the assessment of the mechanism of fracture. Separated by a hyphen, this designation follows the designation of the position given in **2**.

3.2 Examples of the system are as follows (further examples are shown in Figures 6 to 8):

a) A notched test piece as described in **2.4** (b), whose notch is normal to the sheet surface so that fracture propagates in the direction of *X*, is called a Y- X-test piece.

b) A notched test piece as described in **2.4** (d) notched so that fracture propagates in the direction of *Z*, is called an XY-Z-test piece.

4. APPLICATION OF THE METHOD OF DESIGNATION TO PROPERTIES LISTED IN MATERIAL SPECIFICATIONS

4.1 Application — As pointed out in Appendix A, the position of the test piece in relation to the deformation fibre is only one of the characteristics required for ascertaining the properties which may be obtained. Moreover, the position of a test piece relative to the fibre is only sufficiently defined in single products whose production and processing are well known. Therefore, the position relative to the direction of the deformation fibre, the geometrical position in the product, and the various additional effects mentioned in Appendix A shall, as a rule, be taken into account when estimating the importance of a special position of the test piece.

4.2 Limits of Application

4.2.1 The system described shall be used to designate the position of test pieces relative to the direction of the deformed fibres whenever a uniform fibre direction may be identified. In all other cases, the location of the test piece shall be related to component geometry and marked on a drawing of the same, together with a brief description of the method of production of the component (for example, casting, upset forging, etc).

4.2.2 The aspects under which various positions in various products may be combined depend on circumstances and may differ, more or less, from one another. Thus definite numerical relations of the property values which have been obtained in this way for various classifications of the position of the test piece in relation to the deformation fibre apply to the particular case only and may not be generalized.

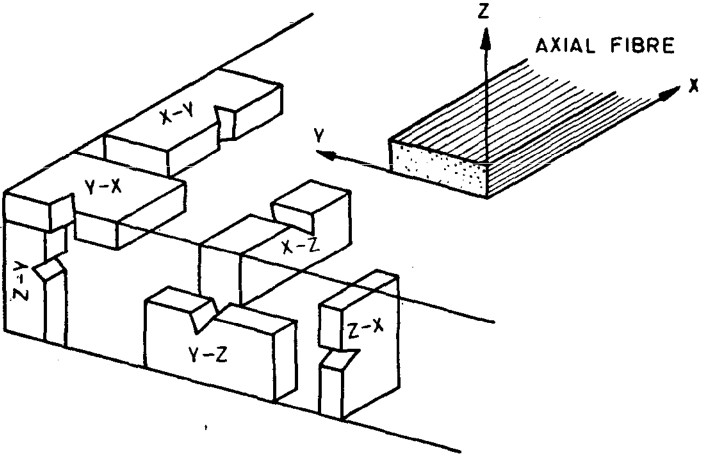

FIG. 6 BASIC FRACTURE PLANE-FLAT ROLLED PRODUCTS

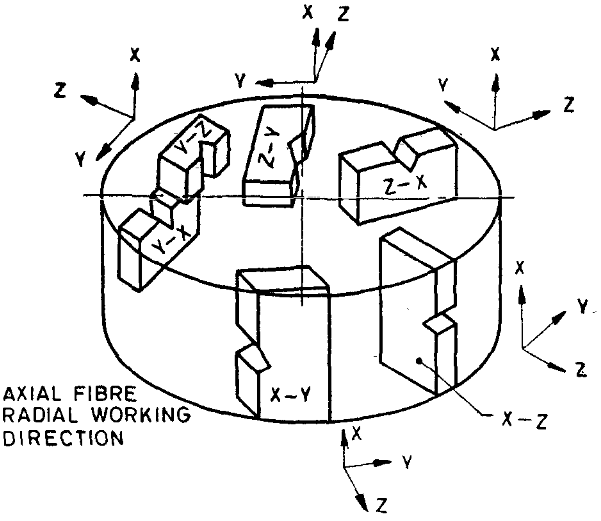

FIG. 7 FRACTURE PLANE-CYLINDRICAL SECTIONS

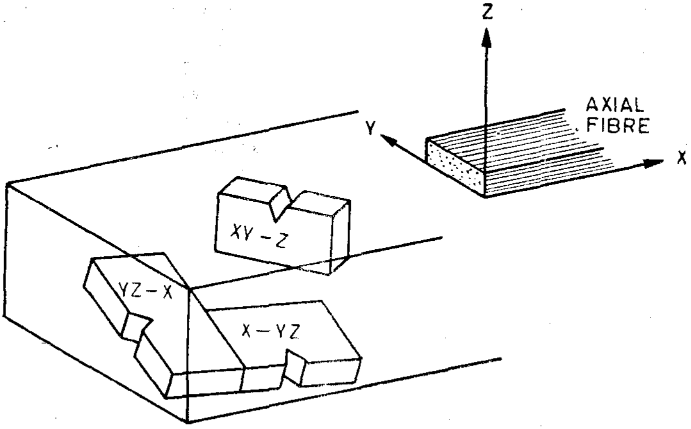

Fig. 8 Non-Basic Fracture Plane

APPENDIX A

(*Clauses* 1.3 *and* 4.1)

INFLUENCE OF MECHANICAL WORKING ON MATERIAL STRUCTURE AND PROPERTIES

A-1. The effect of the position of the test piece with respect to fibre deformation is due to the fact that the metal may become progressively more anisotropic when being processed into products (sheet, bars, etc). The main reason for this is the crystalline, grainlike structure of the metal. After solidification, that is, before deformation, the crystallites may have a more or less globular or stalk-like form. During hot forming the globular crystallites are stretched and possibly flattened so as to become filiform or lamellar, and the stalk-like crystallites are bent to a greater or lesser extent into the main direction of deformation while also being stretched and possibly flattened. If test pieces are stressed in a direction parallel or normal to these fibres, or in some other direction, the values of the properties measured, in particular those indicating toughness or deformability, will vary. Thus, they are dependent on the direction of the stress in relation to the direction of the fibres.

A-2. In most cases the geometry of the product will present a clear indication of the direction of the fibre. For example, the fibres of rolled bars are parallel to the bar axis. The lamellar fibres of a sheet follow the main rolling direction, that is, they are parallel to the longitudinal axis of the sheet, the broad face of the lamellae being parallel to the sheet surface.

Because of this frequent coincidence of the fibre axis with the longitudinal axis, the position of the test piece (that is, the direction of its longitudinal axis) used to be related almost invariably to the geometry of the product. Test pieces taken parallel to the longitudinal axis of a rolled bar (or parallel to the deformation fibre) are therefore called longitudinal test pieces, whereas test pieces taken in a transverse direction to the longitudinal axis (or transverse to the deformation fibre) are called transverse test pieces.

However, particularly in the case of forgings, designations referring to the geometry of the product, such as trangential test pieces, radial test pieces or axial test pieces, are often insufficient to define the position of the test piece with respect to the metal fibre, if the method of production is not indicated.

A-3. In addition to the position of the test piece in relation to the direction of the fibre, other factors are also important, such as the type of product, its metallurgical production, its processing and its heat treatment. When assessing the position of a test piece with regard to the properties which may be obtained, all these factors should be taken into account. This, however, may only be done in the relevant material specifications.

INDIAN STANDARDS
RELATING TO
METHODS OF PHYSICAL TESTS ON STEEL

IS:	
649-1963	Methods for testing steel sheets for magnetic circuits of power electrical apparatus (*revised*)
1403-1959	Reverse bend test for steel sheets and strips less than 3 mm thick
1499-1959	Charpy impact test (U-notch) for steel
1500-1968	Brinell hardness test for steel (*first revision*)
1501-1968	Vickers hardness test for steel (*first revision*)
1521-1972	Tensile testing of steel wire (*first revision*)
1586-1968	Rockwell hardness test (B & C scale) for steel (*first revision*)
1598-1960	Izod impact test for steel
1599-1974	Bend test for steel products other than sheet, strip, wire and tube (*first revision*)
1608-1972	Tensile testing of steel products (*first revision*)
1663-1972	Tensile testing of steel sheet and strip of thickness 0·5 mm to 3 mm (*first revision*)
1692-1974	Simple bend testing of steel sheet and strip less than 3 mm thickness (*first revision*)
1716-1971	Reverse bend testing of steel wire (*first revision*)
1717-1971	Simple torsion testing of steel wire (*first revision*)
1756-1974	Modified erichsen cupping test for steel sheet and strip (*first revision*)
1757-1974	Beam impact test (V-notch) on steel (*first revision*)
1894-1972	Tensile testing of steel tubes (*first revision*)
2328-1963	Flattening test on steel tubes
2329-1963	Bend test on steel tubes
2330-1963	Flanging test on steel tubes
2335-1963	Drift expanding test on steel tubes
3711-1966	Selection and preparation of samples and test pieces for mechanical test for wrought steel
3803-1974	Elongation conversions for steel (*first revision*)
3848-1966	End quench test for hardenability of steel
5072-1969	Method for rockwell superficial hardness test (N&T scale) for steel
5074-1969	Method for axial load fatigue testing of steel
5075-1969	Method of rotating bar bending fatigue testing of steel
5242-1969	Methods of test for determining shear strength of mild steel

INTERNATIONAL SYSTEM OF UNITS (SI UNITS)

Base Units

Quantity	*Unit*	*Symbol*
Length	metre	m
Mass	kilogram	kg
Time	second	s
Electric current	ampere	A
Thermodynamic temperature	kelvin	K
Luminous intensity	candela	cd
Amount of substance	mole	mol

Supplementary Units

Quantity	*Unit*	*Symbol*
Plane angle	radian	rad
Solid angle	steradian	sr

Derived Units

Quantity	*Unit*	*Symbol*	*Conversion*
Force	newton	N	1 N = 1 kg.1 m/s^2
Energy	joule	J	1 J = 1 N.m
Power	watt	W	1 W = 1 J/s
Flux	weber	Wb	1 Wb = 1 V.s
Flux density	tesla	T	1 T = 1 Wb/m^2
Frequency	hertz	Hz	1 Hz = 1 c/s (s^{-1})
Electric conductance	siemens	S	1 S = 1 A/V
Pressure, stress	pascal	Pa	1 Pa = 1 N/m^2